PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-148496

(43)Date of publication of application : 29.05.2001

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(51)Int.Cl. H01L 31/042
H01L 31/04

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(54) SOLAR CELL MODULE AND METHOD OF MANUFACTURING SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an inexpensive and easy-to-manufacture solar cell module exhibiting excellent long term reliability by protecting a conductor tape or a backside electrode against corrosion due to moisture which enters the module through the side face of a sealing material.

SOLUTION: In the method for manufacturing a solar cell module comprising a solar cell including a transparent insulating substrate 1, a transparent electrode layer 2, a semiconductor photoelectric conversion layer 3 and a backside electrode layer 4 formed sequentially on the transparent insulating substrate 1, and a material for sealing the backside of the solar cell, the sealing material comprises a main sealing material 7 formed of EVA covering the central part on the backside of the solar cell, and a steam barrier material 8 formed of polyisobuthylene based resin covering the circumferential fringe part on the backside of the solar cell wherein the steam barrier material 8 has steam permeability of 1 g/m2.day or less at the film thickness of 100 μm.

CLAIMS

[Claim(s)]
[Claim 1]A transparent insulating substrate.
A photovoltaic cell which consists of a transparent electrode layer, a semiconductor photoelectric conversion layer, and a back electrode layer which were laminated one by one on said transparent insulating substrate, and a sealing agent which closes a rear face of said photovoltaic cell.
Are the above the solar cell module which it had, and said sealing agent, It becomes a wrap main sealing agent from wrap steam barrier material about an edge part of a rear face of said photovoltaic cell in a center section of the rear face of said photovoltaic cell, and is characterized by moisture vapor transmission of said steam barrier material being below 1 g/m^2 and day in 100 micrometers of thickness.

[Claim 2]The solar cell module according to claim 1, wherein said steam barrier material is formed also in the side of said transparent insulating substrate.
[Claim 3]The solar cell module according to claim 1 or 2, wherein said steam barrier material is formed so that the range of less than 5 mm may be covered from a periphery on said rear face of a transparent insulating substrate.
[Claim 4]Said steam barrier material Polyisobutylene system resin, urethane system isobutylene resin, Claims 1 thru/or 3 being the materials containing at least one sort chosen from a group which consists of silicone series isobutylene resin, urethane system adhesives, acrylate system adhesives, and epoxy adhesive are the solar cell modules of a statement either.
[Claim 5]As for said main sealing agent, claims 1 thru/or 4 using an ethylene-vinylacetate copolymer as the main ingredients are the solar cell modules of a statement either.
[Claim 6]A manufacturing method of a solar cell module characterized by comprising

the following.

A process of forming a photovoltaic cell which has the structure which laminated a transparent electrode layer, a semiconductor photoelectric conversion layer, and a back electrode layer one by one on a transparent insulating substrate.

A process of covering the center section for a rear face of said photovoltaic cell with the main sealing agent, respectively with steam barrier material whose moisture vapor transmission is below 1 g/m^2 and day in 100 micrometers of thickness about the edge part.

A process of stiffening said main sealing agent and steam barrier material, and closing a rear face of said photovoltaic cell.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]Especially this invention relates to a solar cell module which has improved long term reliability, and a manufacturing method for the same about a solar cell module.

[0002]

[Description of the Prior Art]In recent years, development of clean new energy is desired from the problem of exhaustion of fossil energy resources, an environmental problem like the increase in CO_2 in the atmosphere, etc., and especially photovoltaics is expected. The crystal system solar cell using single crystal silicon, polycrystalline silicon, etc. is already put in practical use as an outdoor solar cell for electric power. On the other hand, since there is little raw material and it ends, the thin film system solar cell using amorphous silicon etc. attracts attention as a low cost solar cell.

Development is furthered briskly now.

[0003]SnO_2 by which the thin film system solar cell module was laminated one by one on the glass substrate, It has a photovoltaic cell which comprises a back electrode layer which consists of metal, such as a semiconductor photoelectric conversion layer which consists of a transparent electrode layer which consists of transparent conductive oxides, such as ZnO and ITO, an amorphous silicon, etc. and aluminum, Ag, and Cr. Above-mentioned each class is divided so that it may correspond to two or more unit cells, it is connected in series and the unit cell which adjoins each other mutually is integrated.

[0004]And the sealing agent sheet in which the rear face of a photovoltaic cell consists of thermosetting resin, such as an ethylene-vinylacetate copolymer (EVA), for example, And the back cover film which consists of polyvinyl fluoride (for example, Du Pont TEDORA), or polyvinyl fluoride / aluminum / polyvinyl fluoride is laminated, and it is closed by the vacuum laminating method etc.

[0005]There is an advantage that EVA used as a sealing agent in the conventional solar cell module has a refractive index close to glass, and it is cheap. However, performances of EVA, such as a water resisting property, moisture resistance, and alkali resistance, are insufficient. For this reason, moisture invaded easily from the portion which EVA exposed especially on the side of the solar cell module, and it became a cause which a conductor tape and a back electrode layer corrode, and was inferior to long term reliability.

[0006]In order to acquire reliability, applying isobutylene isoprene rubber etc. to the circumference of a solar cell module may be performed. However, long term reliability is not acquired from the adhesive badness of isobutylene isoprene rubber in this case.

[0007]In order to solve this problem, the steam barrier material which uses polyisobutylene (PIB) system resin as the main ingredients as a sealing agent independently, Or laminating and using the steam barrier material which uses an EVA layer and PIB system resin as the main ingredients is proposed (for example, JP,6-61518,A, JP,7-142748,A, etc.).

[0008]However, when applying and stiffening PIB system resin all over the rear face of a solar cell module, since the amount of the PIB system resin used with it difficult [to apply PIB system resin to a large area uniformly] and a price high moreover comparatively increases, the price of solar cell modules rises. When PIB system resin is formed on an EVA layer, there is also a problem that the surface smoothness of the rear face of a solar cell module worsens.

[0009]

[Problem(s) to be Solved by the Invention]The purpose of this invention is shown in the long term reliability which prevented the corrosion of the conductor tape by invasion of the moisture which lets the sealing agent side pass, or a rear electrode, and was

excellent, and it is cheap and providing an easy solar cell module has manufacture.

[0010]

[Means for Solving the Problem]A photovoltaic cell which a solar cell module of this invention becomes from a transparent electrode layer, a semiconductor photoelectric conversion layer, and a back electrode layer which were laminated one by one on a transparent insulating substrate and a transparent insulating substrate, In a solar cell module which it had, a sealing agent which closes a rear face of a photovoltaic cell a sealing agent, It becomes a wrap main sealing agent from wrap steam barrier material about an edge part of a rear face of a photovoltaic cell in a center section of the rear face of a photovoltaic cell, and is characterized by moisture vapor transmission of said steam barrier material being below 1 g/m^2 and day in 100 micrometers of thickness.

[0011]As for steam barrier material, in this invention, it is preferred to be formed also in the side of a transparent insulating substrate from a waterproof and damp-proof viewpoint. As for steam barrier material, it is preferred to be formed so that the range of less than 5 mm may be covered from a periphery on a rear face of a transparent insulating substrate.

[0012]As a material of steam barrier material which fulfills conditions of being below 1 g/m^2 and day in 100 micrometers of thickness, in this invention, Polyisobutylene system resin, urethane system isobutylene resin, silicone series isobutylene resin, urethane system adhesives, acrylate system adhesives, epoxy adhesive, etc. are used.

[0013]In this invention, what uses an ethylene-vinylacetate copolymer (EVA) as the main ingredients, for example is used considering a center section of the rear face of a photovoltaic cell as a wrap main sealing agent.

[0014]This invention is characterized by a manufacturing method of a solar cell module comprising the following.

A process of forming a photovoltaic cell which has the structure which laminated a transparent electrode layer, a semiconductor photoelectric conversion layer, and a back electrode layer one by one on a transparent insulating substrate.

A process of covering the center section for a rear face of said photovoltaic cell with the main sealing agent, respectively with steam barrier material whose moisture vapor transmission is below 1 g/m^2 and day in 100 micrometers of thickness about the edge part.

A process of stiffening said main sealing agent and steam barrier material, and closing a rear face of said photovoltaic cell.

[0015]

[Embodiment of the Invention]As mentioned above, in the solar cell module of this invention, the center section of the rear face of a photovoltaic cell is covered with the main sealing agent, and the edge part of the rear face of a photovoltaic cell is covered with steam barrier material. After such a solar cell module forms a photovoltaic cell on

a glass substrate, The sheet of the main sealing agent is put on the rear-face center section of the photovoltaic cell, steam barrier material material is applied to the rear-face edge part of a photovoltaic cell, a protective sheet is carried further, and it is manufactured by carrying out heat cure of the main sealing agent and the steam barrier material using a vacuum laminating machine.

[0016]In this invention, since steam barrier material material is applied only to the rear-face edge part of a photovoltaic cell, and there is little amount of the material used with easy spreading activities and a price high moreover comparatively and it ends, a price hike of a solar cell module can be suppressed. Since the main sealing agent and steam barrier material can be formed in the almost same thickness, the surface smoothness of the rear face of a solar cell module becomes good.

[0017]In this invention, the material below 1 g/m^2 and day is used for moisture vapor transmission by 100 micrometers of thickness as a steam barrier material. As a material of the steam barrier material which fulfills this condition, although polyisobutylene system resin, urethane system isobutylene resin, silicone series isobutylene resin, urethane system adhesives, acrylate system adhesives, epoxy adhesive, etc. are mentioned, Especially the polyisobutylene system resin that has rubber elasticity from a point of insulation and intensity is preferred.

[0018]About the curing method of these constituents, there is no restriction in particular and can choose various curing methods, for example, if it is polyisobutylene system resin, For example, the method of carrying out polymerization curing of the material which consists of the isobutylene system polymer which has a carbon-carbon double bond at the end which is indicated by JP,6-49365,A, a hardening agent which has two or more hydrosilyl groups, and a constituent containing a catalyst, Or the method of polymerizing isobutylene system polymer and the isocyanate compound which have a hydroxyl group, and the constituent containing a curing catalyst is mentioned to an end. Other additive agents may be added, such as adding a plasticizer, in order to adjust the viscosity of a constituent. By hardening the constituent containing these ingredients, the steam barrier material which consists of a hardened material which has rubber elasticity can be formed. If such a steam barrier material is used, it is advantageous to carrying out flattening of the main sealing agent and the steam barrier material.

[0019]

[Example]Hereafter, the example of this invention is described with reference to drawings.

[0020]Drawing 1 is a sectional view showing the edge part of the solar cell module concerning this invention. The transparent electrode layer 2 which consists of SnO_2 is formed on the glass substrate 1 which consists of soda lime glass (an area of 92 cm x 46 cm, and 4 mm in thickness). Corresponding to two or more unit cells, the scribe of this transparent electrode layer 2 is carried out in the position of the scribe line 2a, and it is divided into the string width of about 10 mm. On the transparent electrode layer 2, the

semiconductor photoelectric conversion layer 3 of an amorphous silicon system which has a pin junction is formed. The scribe of the semiconductor photoelectric conversion layer 3 is carried out in the position of the scribe line 3a shifted about 100 micrometers from the scribe line 2a of the transparent electrode layer 2. This scribe line 3a serves as an opening for connection of the transparent electrode layer 3 and a back electrode layer. On the semiconductor photoelectric conversion layer 3, the back electrode layer 4 formed by laminating ZnO and Ag is formed. From the scribe line 3a of the semiconductor photoelectric conversion layer 3, in the position of the scribe line 4a shifted about 100 micrometers, the scribe of the back electrode layer 4 and the semiconductor photoelectric conversion layer 3 by the side of the surface is carried out, and they are divided. Two or more unit cells (string width is about 10 mm) are connected in series as mentioned above, it is formed, and the integration thin film solar cell cell is produced.

[0021]In order to separate a photovoltaic cell electrically from the exterior over the perimeter of the glass substrate 1, laser removes a transparent electrode layer, a semiconductor photoelectric conversion layer, and a back electrode layer from the periphery of the glass substrate 1 in a 5-mm position, and it is considered as the insulated separation field. The semiconductor photoelectric conversion layer and back electrode layer outside the string in both ends are removed by a width of about 3.5 mm, and it is considered as the wiring area. The solder 5 is attached to this wiring area, and the bus bar electrode 6 which consists of solder plate copper foil is formed on it. This bus bar electrode 6 is arranged at the string of a photovoltaic cell, and parallel. A conductor tape (not shown) is connected to the bus bar electrode 6.

[0022]Next, as shown in a perspective view, an EVA sheet is put on the rear-face center section of the photovoltaic cell as the main sealing agent 7 at drawing 2, and polyisobutylene system resin is applied as the steam barrier material 8 so that the rear-face edge part of a photovoltaic cell may be covered. The range which applies the steam barrier material 8 is made into the range of less than 5 mm from the periphery of the glass substrate 1, and the steam barrier material 8 is kept from contacting the bus bar electrode 6 and the rear electrode 4 at this time. The back cover film 9 which consists of polyvinyl fluoride / aluminum / polyvinyl fluoride on the sealing agent which consists of the main sealing agent 7 and the steam barrier material 8 is piled up, and it closes with a vacuum laminator. The conditions of the heat cure by a vacuum laminating machine are about 30 minutes at 150 **. The main sealing agent and steam barrier material carry out bridge construction hardening under these conditions, respectively. Under the present circumstances, the side of the glass substrate 1 is also covered with the steam barrier material 8 as a result of flow of polyisobutylene system resin. The thickness of about 0.6 mm and the back cover film 9 of the thickness of the main sealing agent 7 and the steam barrier material 8 is 110 micrometers.

[0023]Thus, the output was 32W as a result of measuring the current potential

characteristic about the obtained solar cell module using AM1.5 solar simulator of 100 mW/cm^2. After carrying out 1 time processing of this solar cell module by PCT (120 ** and 2 atmospheres) (pressure cooker test), the visual examination of it was conducted, but the corrosion of the rear electrode was not seen.

[0024]The solar cell module was produced like the above-mentioned example except having used only EVA as a sealing agent and having covered the whole rear-face surface of the photovoltaic cell for comparison. Thus, as a result of measuring the current potential characteristic about the obtained solar cell module using AM1.5 solar simulator of 100mW[/cm] ^{2}, an output is 32W and showed the output equivalent to the above-mentioned example. The corrosion of the rear electrode considered for invasion of the moisture from an edge part to be the cause when 120 **, 2 atmospheres, and PCT processing of 1 hour are similarly performed in this solar cell module was accepted.

[0025]

[Effect of the Invention]As explained in full detail above, in this invention, the sealing agent which consists the edge part of the rear face of a wrap main sealing agent and a photovoltaic cell of wrap steam barrier material in the center section of the rear face of a photovoltaic cell is used.

Therefore, it is shown in the long term reliability which prevented the corrosion of the conductor tape by invasion of the moisture which lets the sealing agent side pass, or a rear electrode, and was excellent, and the solar cell module in which it is cheap and manufacture is easy can be provided.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The sectional view showing the edge part of the solar cell module concerning this invention.

[Drawing 2]The perspective view showing the state where the main sealing agent and steam barrier material have been arranged at the rear face of a solar cell module.

[Description of Notations]

1 -- Glass substrate

2 -- Transparent electrode layer

3 -- Semiconductor photoelectric conversion layer

4 -- Back electrode layer

5 -- Solder

6 -- Bus bar electrode

7 -- Main sealing agent

8 -- Steam barrier material

9 -- Back cover film